Students' project developed for the teaching unit "Proskills" of the Master1 Neurosciences (UCBL1)

Neurotales

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Prologue

This small volume brings together three short stories inspired by the fairy tales we know and love. Each explores themes from neuroscience in the hope that we can spread some of the knowledge that fascinates us. Though fictional and whimsical in form, they contain real, science-backed information, found within the field, in accessible and enjoyable form.

This is a student production: we offer you, dear reader, this, with the hope that it may support or spark your own engagement with neuroscience. Whether you are pursuing it academically, exploring it as an amateur, or simply here to enjoy these stories in passing: we welcome you to our works.

If you like these short stories, please do not hesitate for even a single second, to share this with someone who you think might also find enjoyment herein.
We hope that what we have humbly written can inspire you, just as much as we have been inspired by others, in neuroscience.

Valeria Chacón, Jules Crawley-Monnier, Jérémie Loquet.

Special Thanks to our scientific validators:

Dr. Emiliano Macaluso,

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Alice In Wonderland: Perceiving a Cheshire Cat

Jules Crawley-Monnier | Master's student of first year of Neuroscience at the UCBL1

We approach our story when poor little Alice was at a crossroads and looked left and right. Suddenly, a cat appeared on a tree branch and introduced himself as the cheshire cat:

Alice said, "Would you tell me, please, which way I ought to go from here?"
To which responded the Cheshire Cat, "That depends a good deal on where you want to get to."

"I don't much care where-"

"Then it doesn't matter which way you go."

"-so long as I get somewhere."

"Oh, you're sure to do that, if you only walk long enough."

"But I don't want to go among mad people." Alice exclaimed, "Oh, you can't help that. We're all mad here. I'm mad. You're mad.", he appeared quite giddy as he said this.

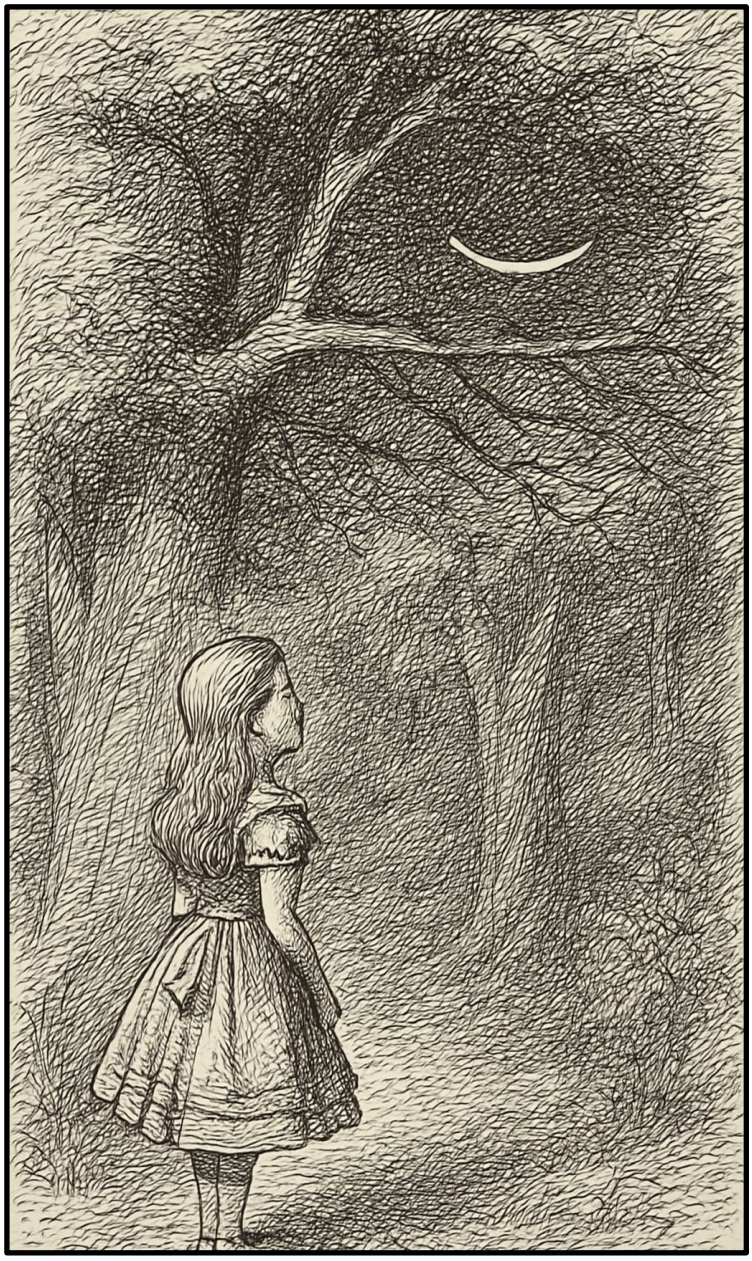
"How do you know I'm mad?"

"You must be, or you wouldn't have come here."

The Cheshire Cat's grin widened impossibly across his face "Well, then, you see, a dog growls when it's angry, and wags its tail when it's pleased. Now I growl when I'm pleased, and wag my tail when I'm angry. Therefore, I'm mad."

"I call it purring, not growling." said Alice.

"Call it what you like."



He piped up once again, "Do you play croquet with the Queen to-day?"

"I should like it very much," said Alice, "but I haven't been invited yet."

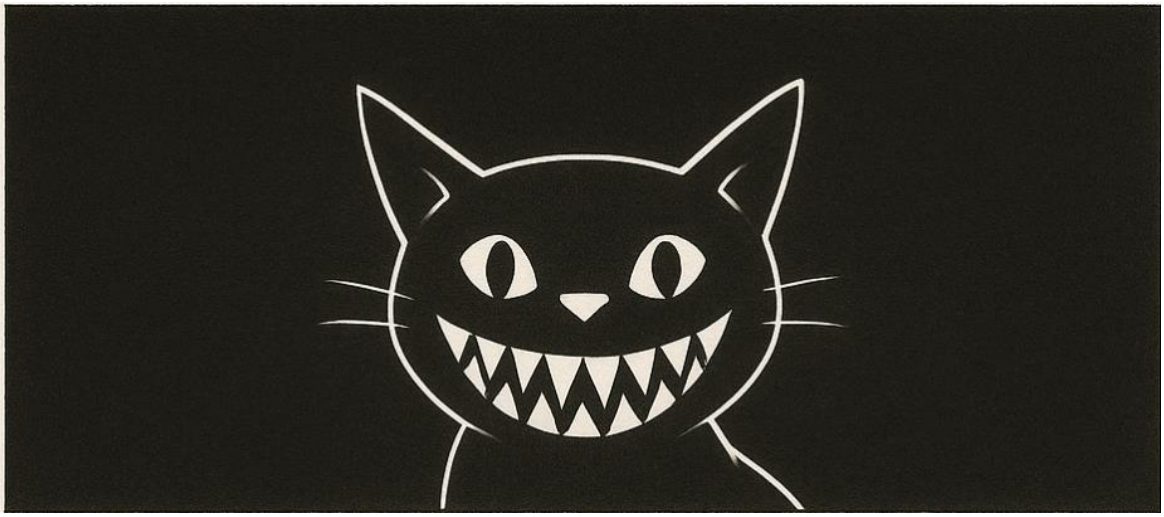
"You'll see me there," said the Cat, and vanished.

Alice was not much surprised at this; she was getting so well used to queer things happening. While she was still looking at the place where it had been, something interesting happened.

At first there was nothing. Then, quite rudely and without so much as a rustle, something did appear.

Alice's brain did what any sensible brain might do when faced with a disembodied curve: it began at the beginning: **V1**, the part that handles edges and angles and contrast, very serious about lines but terribly ignorant about *things*. "Here's a line that curves, and another line that curves, with other lines inside," said V1, "though I've no idea what it belongs to or what it is." [1,2]

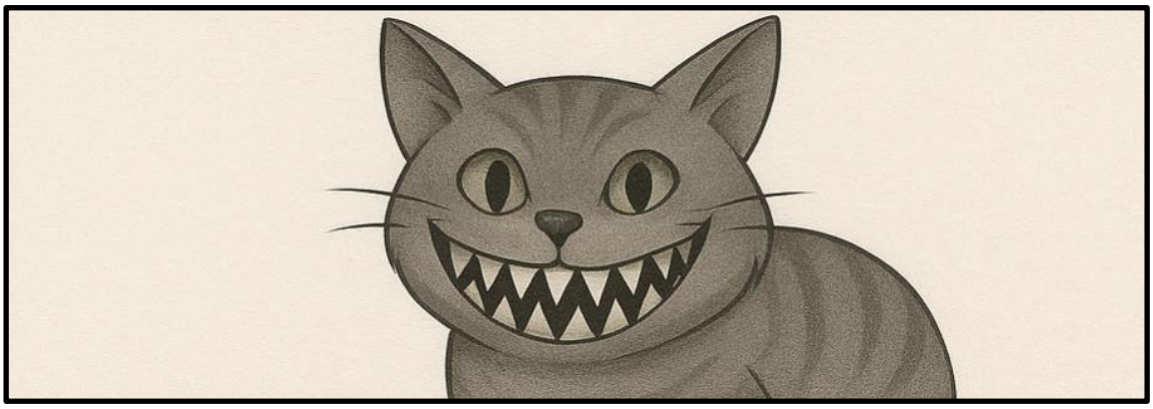
The curve widened, showing more of the little lines. Or perhaps her *sense* of it did. Now there were corners and curves and something almost symmetrical.



V2 piped up next, excited and plucky. It is very fond of *boundaries*, and promptly assembled the lines and edges into shapes. "The curved lines are shaped like a mouth!" it suggested, hopefully. "and the little lines inside make little triangles like teeth!" [3]

Then came a flicker at the sides, showing hints of stripes and whiskers unfurling from the void.

V3 took over. He is obsessed with *motion*, *depth*, and spatial layout. "aha! that curved mouth shape is in front of the triangles!" V3 exclaimed. [4]



Colours bled gently into view: warm gold, sly violet, and the faintest shimmer of a smugly pink tongue.

Here enters **V4**, the grand master of colour and form. “Ah,” said V4, taking everything in quite luxuriously, “this is no longer a sketch; this is a *thing*. I see the triangles are white teeth, and the curves are pink lips” [5]

The face took shape now, those famously impossible eyes, the ears at a tilt, and the body perched quite precisely on a branch that had certainly been empty not a moment ago.

At this stage, **the lateral occipital complex (LOC)** got involved. It’s the part that declares, “*That’s* an object, those white riangles are teeth and those pink curves are lips.” And the **fusiform face area** (the bit for faces, if you can believe it) agreed: “*That’s* a *face,* and one we’ve seen before.” The Cat was back. [6]

The cheshire cat came and went just as Alice saw and perceived him.

But none of these could have done their work without Alice’s **prefrontal cortex**, quietly conducting from the wings. While all those Vs and complexes and areas had taken the

cheshire cat and figured out how the cheshire cat looked, the prefrontal cortex had, even before the first edge appeared, begun to *expect* him. It whispered, before even the first line, to the rest: “I expect we will see a cat, tell me if we’re seeing a cat”

And so, when the Cat finally opened his mouth, quite attached now to a full and frightfully contented self, Alice wasn’t startled at all.

She simply said, “There you are,” as though he’d merely been behind a curtain the whole time.

That, you see, is how perception works: first we detect, then we build, then we name, tough at the same time, we *guess*, and guess so well it looks like truth. And when the world cooperates, or the Cat decides to oblige, it all seems quite natural indeed.

"By-the-bye, what became of the baby?" said the Cat. "I'd nearly forgotten to ask."
"It turned into a pig," Alice answered very quietly, just as if the Cat had come back in a natural way.
"I thought it would," said the Cat, and vanished again.

Alice waited a little, half expecting to see it again, but it did not appear, and after a minute or two she walked on in the direction in which the March Hare was said to live. "I've seen hatters before," she said to herself; "the March Hare will be much the most interesting, and perhaps, as this is May, it won't be raving mad—at least not so mad as it was in March." As she said this, she looked up, and there was the Cat again, sitting on a branch of a tree.

"Did you say 'pig', or 'fig'?" said the Cat.
"I said 'pig'," replied Alice; "and I wish you wouldn't keep appearing and vanishing so suddenly: you make one quite giddy!"
"All right," said the Cat; and this time it vanished quite slowly, beginning with the end of the tail, and ending with the grin, which remained some time after the rest of it had gone.

"Well! I've often seen a cat without a grin," thought Alice; "but a grin without a cat! It's the most curious thing I ever saw in all my life!"

CINDERELLA: HOW LOVE WORKS ON OUR BRAIN

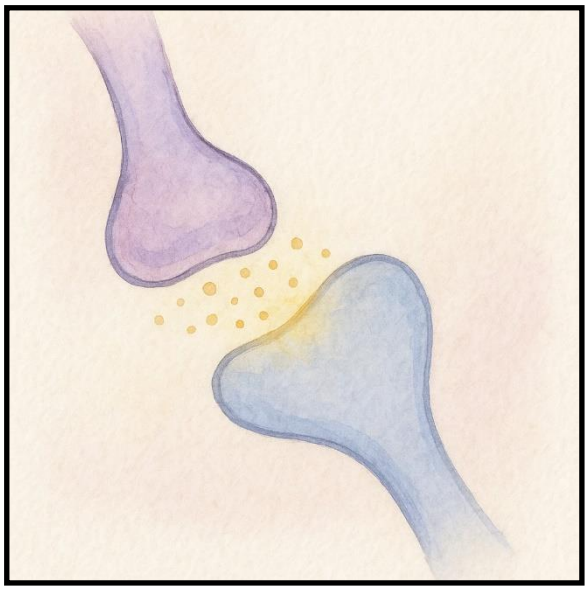
Valeria Chacón | Master's student of first year of Neuroscience at the UCBL1

"… The prince himself came to greet her. When he saw the beautiful, mysterious princess, he immediately fell in love… They had never seen the prince look so happy!" Cinderella; or, The Little Glass Slipper by Charles Perrault

The story of Cinderella is widely known around the world. The climax unfolds when she arrives at the castle, and Prince Charming instantly falls in love with her. This moment may feel familiar to many—perhaps you've experienced something similar: an intense attraction to someone across a room or the sensation of "love at first sight."

The sudden "craziness" people feel in such moments is not just poetic—it is driven by evolutionary mechanisms that push individuals to seek connection, step out of their comfort zones, and form bonds. These sensations are often accompanied by idealization, a desire for closeness, and subconscious cognitive signals that result in attention-seeking behavior, acts of service, or the urge for physical proximity.[1]

This is reflected in the story. When Cinderella disappears at midnight, the prince mobilizes his entire kingdom to find her. What drives someone to such an extreme effort? Surely, in real life, we don't send armies to reduce the distance between ourselves and the object of our affection... or do we? …In fact, fairy tales aren't the only places where passion shapes dramatic actions. Think of *The Iliad* by Homer, *Antony and Cleopatra* by Shakespeare, or *Lancelot* by Chrétien de Troyes—love has inspired bold, sometimes irrational, acts across all of human history. So, what happens in the brain during these powerful emotional states? What might have been occurring in Cinderella's and Prince Charming's brains at that exact moment of connection?



Let’s start by defining a neurotransmitter: a chemical substance synthesized and released by neurons that transmits signals to other cells, typically across a gap called the synaptic cleft, which is the small space between two neurons.[2] When romantic feelings arise, the brain releases a cocktail of neurotransmitters and hormones that orchestrate this emotional experience. Those, are present on different areas of the brain, during different stages of love.

During the initial step of love, the so-called spark that the Prince felt when his eyes locked on Cinderella across the room, probably triggered a flow of dopamine and intense activity in areas of the brain such as the ventral tegmental area (VTA) and the nucelus accumbens, both involved in the reward system.[1,3,4] If we regard the brain as a palace, VTA would be a royal scribe that takes notice of events that bring joy, excitement and reward, and then sends the information to the nucleus accumbens -the royal herald- who amplifies the message to the entire court.

All this generates the euphoric “spark” of a new romantic interest. Dopamine is like a fuel on those areas that stimulate feelings of desire, pleasure, novelty-seeking and motivation. This explains the sudden surge of joy and fascination: Cinderella was beautiful and mysterious, which the brain interpreted as a reward, in face of the possibility on knowing her.[1,3,4]

As they danced throughout the night, their connection deepened. The story does not point to conversations they had, but surely this, aside from the non-verbal cues as eye contact, physical proximity or synchronized movement, helped building their bond. This emotional resonance may have activated the medial insula, region linked to emotional awareness and empathy, at the same time the anterior cingulate cortex (ACC) must have acted by processing their emotions and stablish their decisions based on that growing bond. All of this, regulated in a high degree by serotonin, which reduced levels during early stages of love has been linked to obsessive thoughts and worry. That nervous flutter at the beginning? Surely is a mix of dopamine-driven desire and serotonin-related anticipation. [1,3,4]

Sadly, the magic vanished when the clock hit 24:00h and the bells rang, Cinderella departed without even leaving her name. Surely both of their brains and blood flooded with cortisol. Maybe for different reasons, but being a stress hormone, the fear of losing the magic surely hit Cinderella, meanwhile for the Prince it was the fear of losing her. [1]

The initial spark between them was so strong that the Prince was determined to find her, from the moment she disappears. He starts a kingdom-wide search, that might be driven by activation of the caudate nucleus, region associated with long-term reward and goal-directed behavior.[3] Meaning this area worked as a motor, driving his actions towards the goal of finding Cinderella in order to be together.

Once reunited, the hippocampus would activate, opening a treasure chest full of the memories they shared even for a brief time[3]. Then, the story goes on, they marry and live happily ever after and, with them, an extremely important hormone: oxytocin. Known as the bonding hormone, it fosters trust, openness and emotional attachment. It is possible to view this molecule as a bridge between people, for it drives them emotionally close, building trust and the desire for their happiness.[1]

It is important to remember that all these processes don't occur isolated, there is a dynamic for all of them. One of the structures in charge of controlling this is the amygdala: a small, almond-shaped structure buried deep into the brain. Think of it as a smoke detector for emotions. It constantly scans our surroundings for emotional significance: surprise, joy, fear or love. Throughout all the story, the amygdala must have been activated at each step: the joy and excitement of the first meeting or the fear of loss. This little but important structure, helps to assign emotion to every moment we live and makes sure we remember them.[3,5]

So, even if Cinderella's story is fictional, it echoes the complexity of love and emotions. It reflects a reality we all live at one point of our lives and, if we look deeper into it, we can learn that there are several players and structures involved, they build the dynamics for one of the most complex yet beautiful feelings we can ever feel, like an orchestra where the musicians are different molecules, seated in different regions and complementing one another, in order to produce on single and beautiful melody: love.

The tale of appetite: A journey through the brain

Jérémie Loquet | Master's student of first year of Neuroscience at the UCBL1

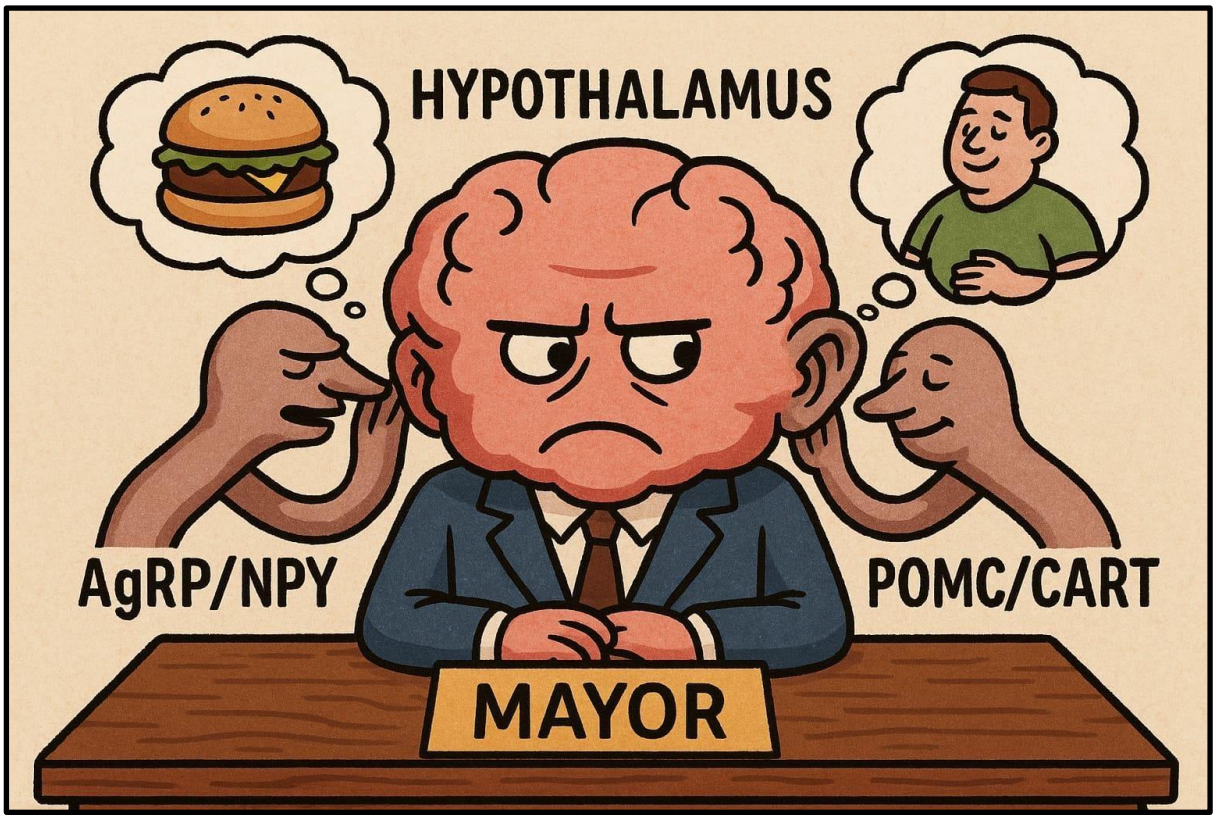
Hansel and Gretel, the fairy tale from Grimms' brothers, relates the story of a starving lumberjack family. The starvation is so strong that it pushes the parents to abandon their own children to their madness in the forest.

We can read: "*La famille ne mangeait guère. Une année que la famine régnait dans le pays et que le pain lui-même vint à manquer […].* » which can be translated by "*The family hardly ate. It was a year when famine gripped the land, and even bread itself came to be scarce […] .".*

Yourself, you may have experienced this feeling when you did not eat for an afternoon.

In this tale, the feeling of appetite drives the family to tough choices. From this tale, we will bring you into the marvellous world of the brain, explaining how does appetite work.

If your body is a city, its headquarters lies a grand control centre: the brain. Deep within this metropolis, the hypothalamus acts as the mayor, tirelessly balancing the city's energy needs. Within the hypothalamus, two rival advisors whisper in the mayor's ear. On one side, the AgRP/NPY duo are ever, they stir up hunger. Making you dream of delicious meals. On the other, the POMC/CART team are guardians of restraint, urging you to slow down and feel satisfied.



To be able to correctly whisper their information, the rival advisors receive messages from a unique guild known as the tanycytes. Unlike most citizens, these slender, glial-like sentinels have feet in two worlds: one side touches the cerebrospinal fluid (the city's river of nutrients and hormones) while the other extends deep into the bustling neighbourhood where hunger and fullness are decided. These glial-like sentinels sense the ebb and flow of nutrients: glucose, amino acids, fatty acids, drifting in the city's river after every meal.

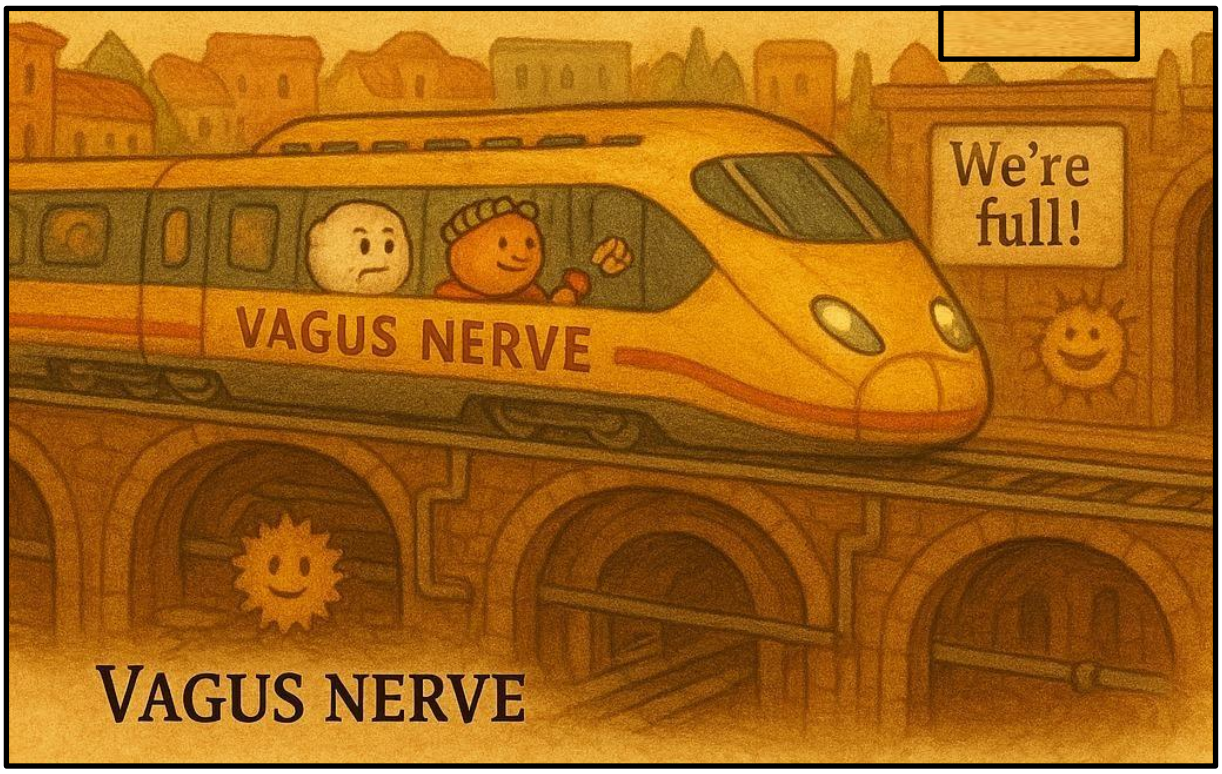
But the mayor doesn't rule alone. Messages arrive from distant lands:

- Ghrelin, the "hunger messenger", rides in from the stomach, especially when it's empty, urging the city to seek food.
- Leptin, the "fullness herald", comes from the fat stores, assuring the mayor that reserves are plentiful and it's time to curb the appetite.
- Insulin and host of gut hormones like CCK, PYY, GLP-1 or amylin send their own notes, updating the mayor on the latest meals and energy status.

Meanwhile, the city's streets are alive with sights and smells. The orbitofrontal cortex (also known as the city's gourmet critic) samples every aroma and flavour, deciding which foods are most tempting. When you see a favourite treat, the mesolimbic reward circuit (the city's festival planner) throws a dopamine-fuelled celebration, making that food irresistible.

Hidden in the city archives, the hippocampus stores memories of past meals. Sometimes, it reminds you of the joy of grandma's cookies, nudging you to eat even when you're not truly hungry.

Beneath the city, a high-speed train: the vagus nerve. It carries real-time message from the gut. When you eat, stretch sensors and chemical signals hop aboard, racing to the brainstem to announce: "We're full!". This helps the mayor make quick decisions about when to stop eating.



When your energy is low, hunger signals rise, and the city's food markets bustle with activity. As you eat, fullness signals gradually quiet the crowds, and the city returns to calm.

But sometimes, the system falters. In times of stress or celebration, the emotional centres, the amygdala and its friends, may override the mayor's orders, leading to extra feasting or lost appetite.

Then, appetite is a grand tale of signals, memories, and emotions, all woven together in the brain's intricate city. It's a dance between hunger and fullness, reward and restraint, ensuring your body gets what it needs, or at least, most of the time.

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